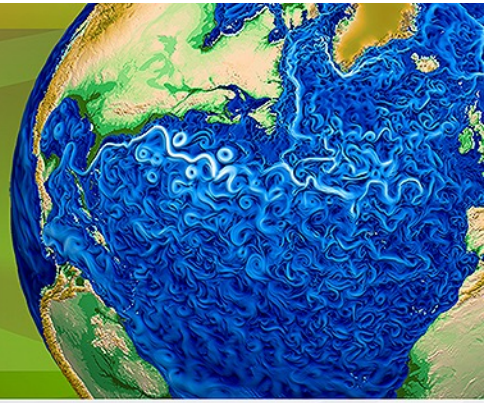
ACME
Accelerated Climate Modeling for Energy



Ocean / Ice Group: Status Report and Future Roadmap

ACME All-Hands Meeting, June 7-9, 2016

U.S. DEPARTMENT OF ENERGY

Science Driver: How do rapid changes in cryospheric systems interact with the climate system?

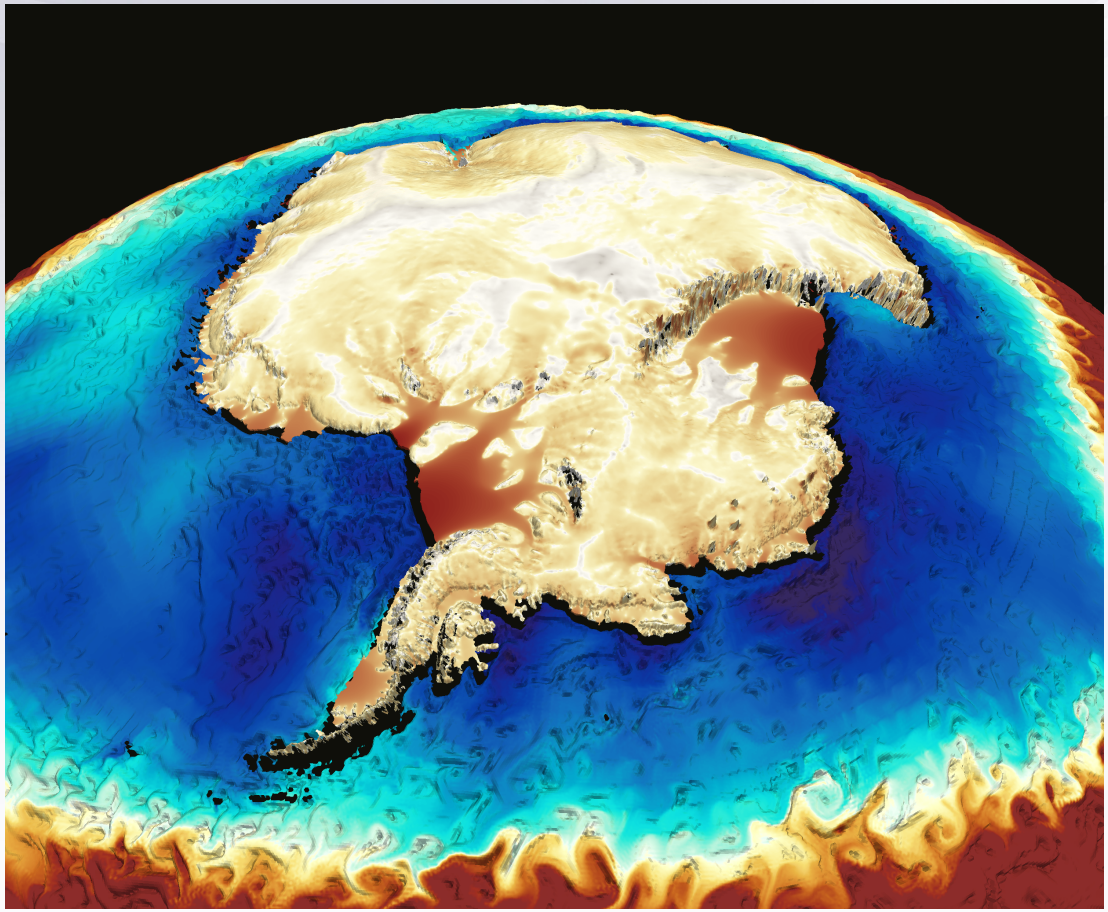
Motivation: Explore likelihood of rapid sea-level rise due to ocean-ice interactions and dynamic ice sheet instabilities.

Effort focus is Antarctica & Southern Ocean.

Target simulations include dynamically-coupled, ocean, atmosphere and land ice systems.

Challenges:

- new ocean, land/sea ice models
- spatial scales down to ~1 km
- Ice sheet / ocean coupling and initial conditions
- sparse observations
- long equilibrium timescales of coupled system



MPAS-Ocean & MPAS-Land Ice model output (uncoupled)

Target Simulation(s)

Time: 1970-2050

Model Components:

atmosphere: default ACME v1

land: default ACME v1

ocean: MPAS-O, RRS 15-to-5 km (possibly ~1 km in regions?)

sea ice: MPAS-SI (same mesh as MPAS-O)

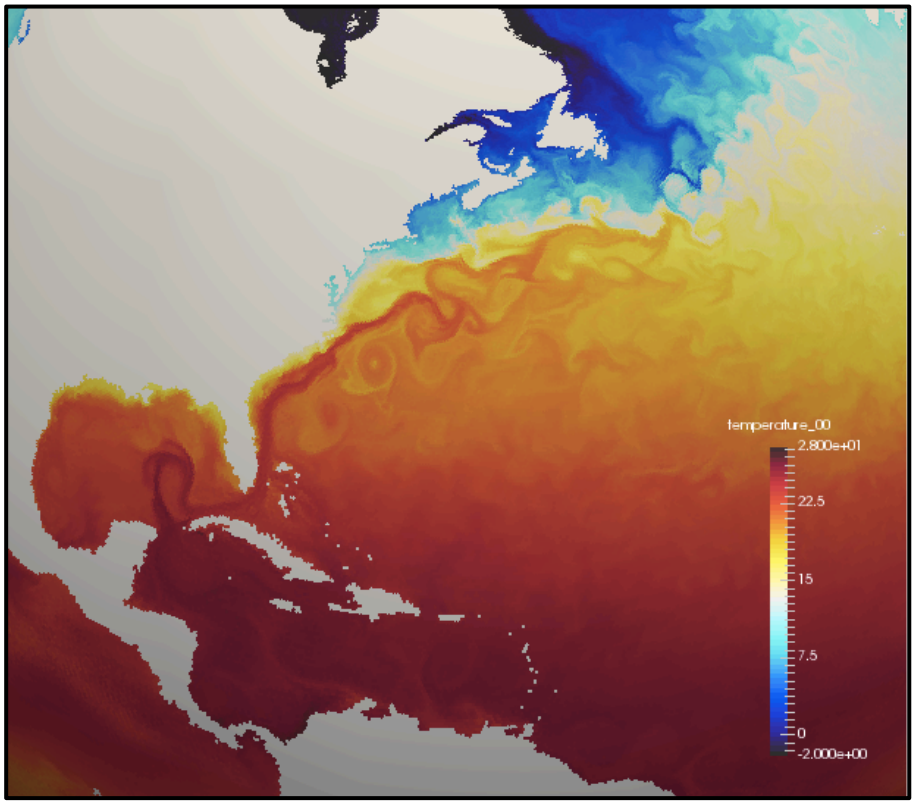
land ice: MPAS-LI / Albany, 20 to <1 km in regions

Initial conditions:

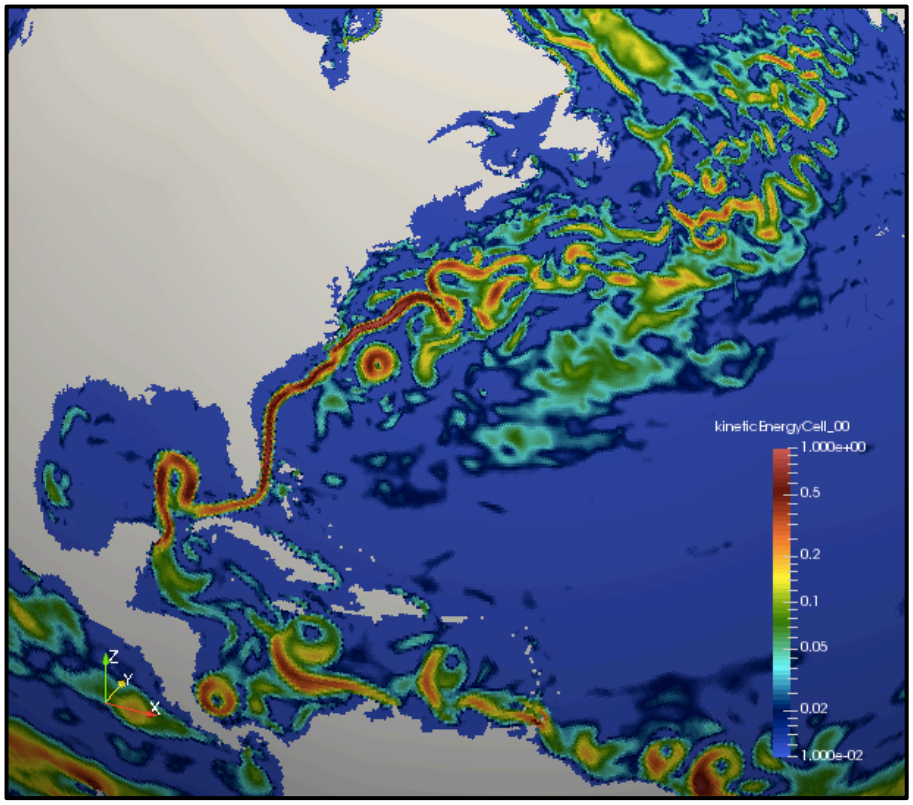
ocean & sea ice: from CORE-II (or low-res, coupled?) spin-up

land ice: optimized in collaboration with PISCEES

MPAS-Ocean



Sea Surface Temperature



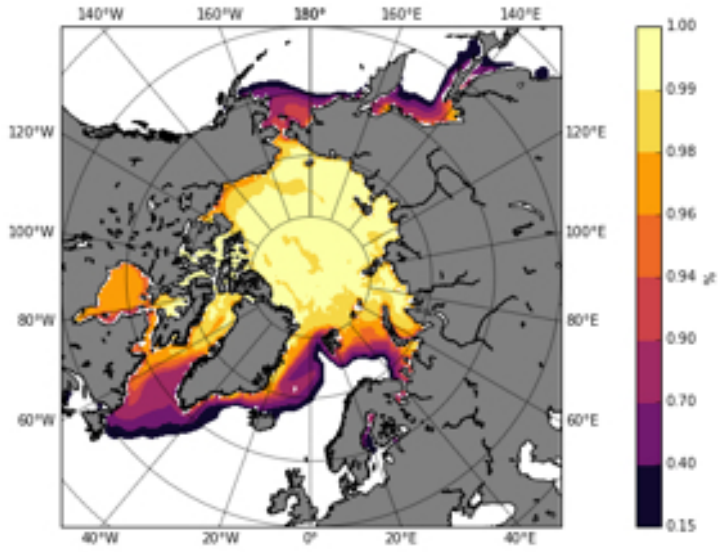
Eddy-Kinetic Energy

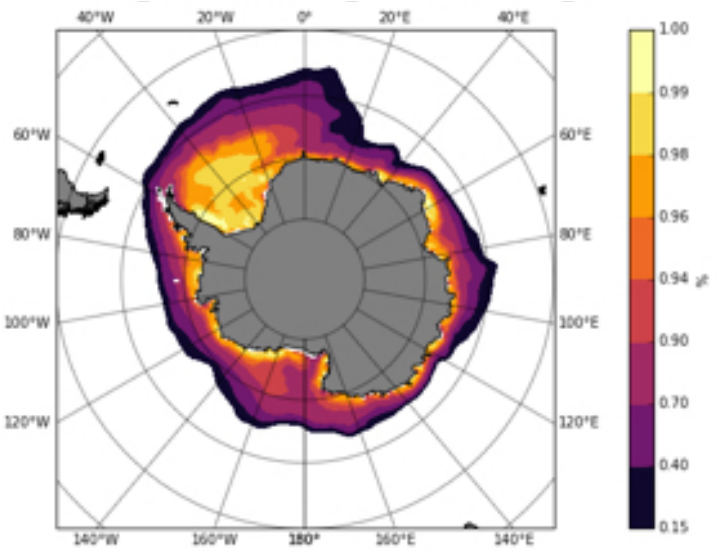
- RRS30to10 km
- G-Case (forced by COREII)

MPAS-Sea Ice

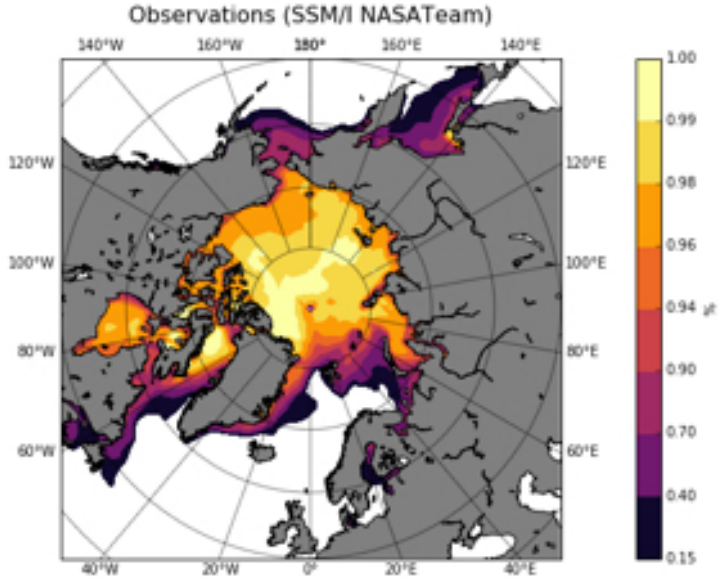
JFM

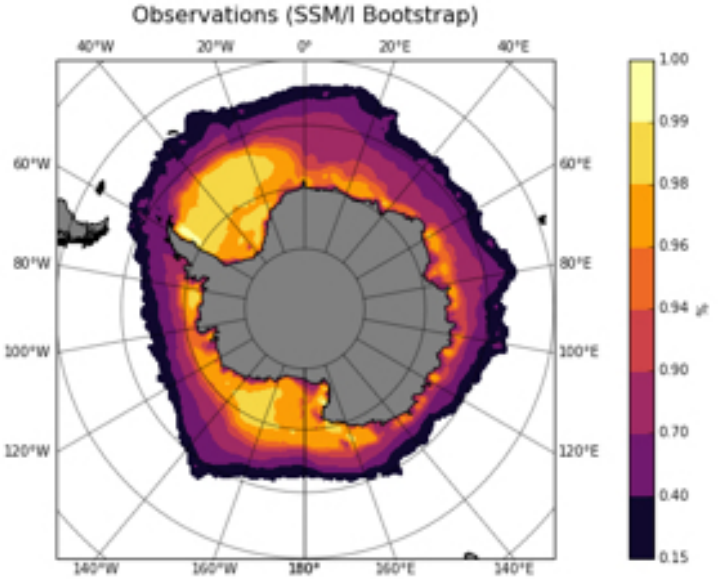
JJA





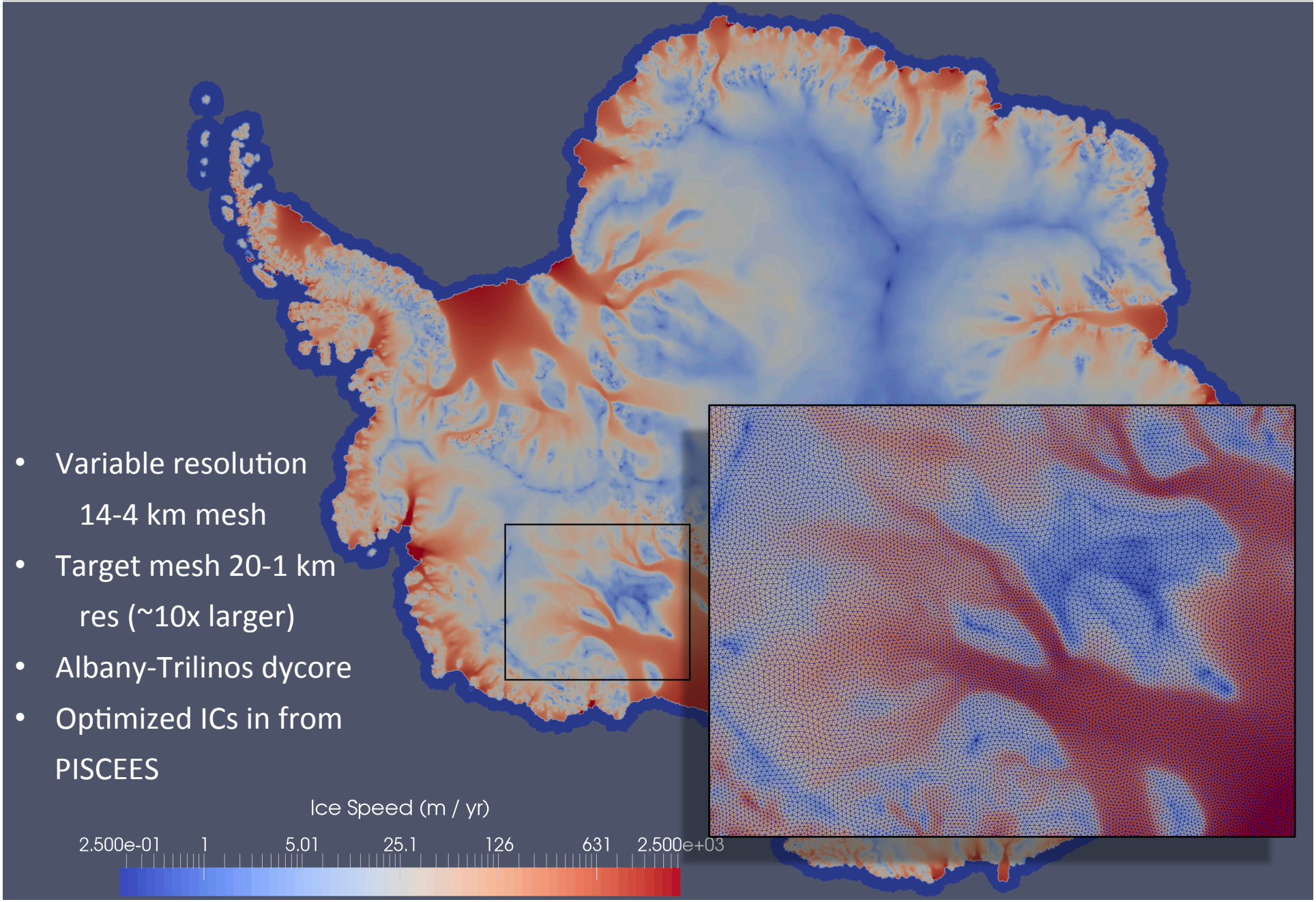
MPAS-SI





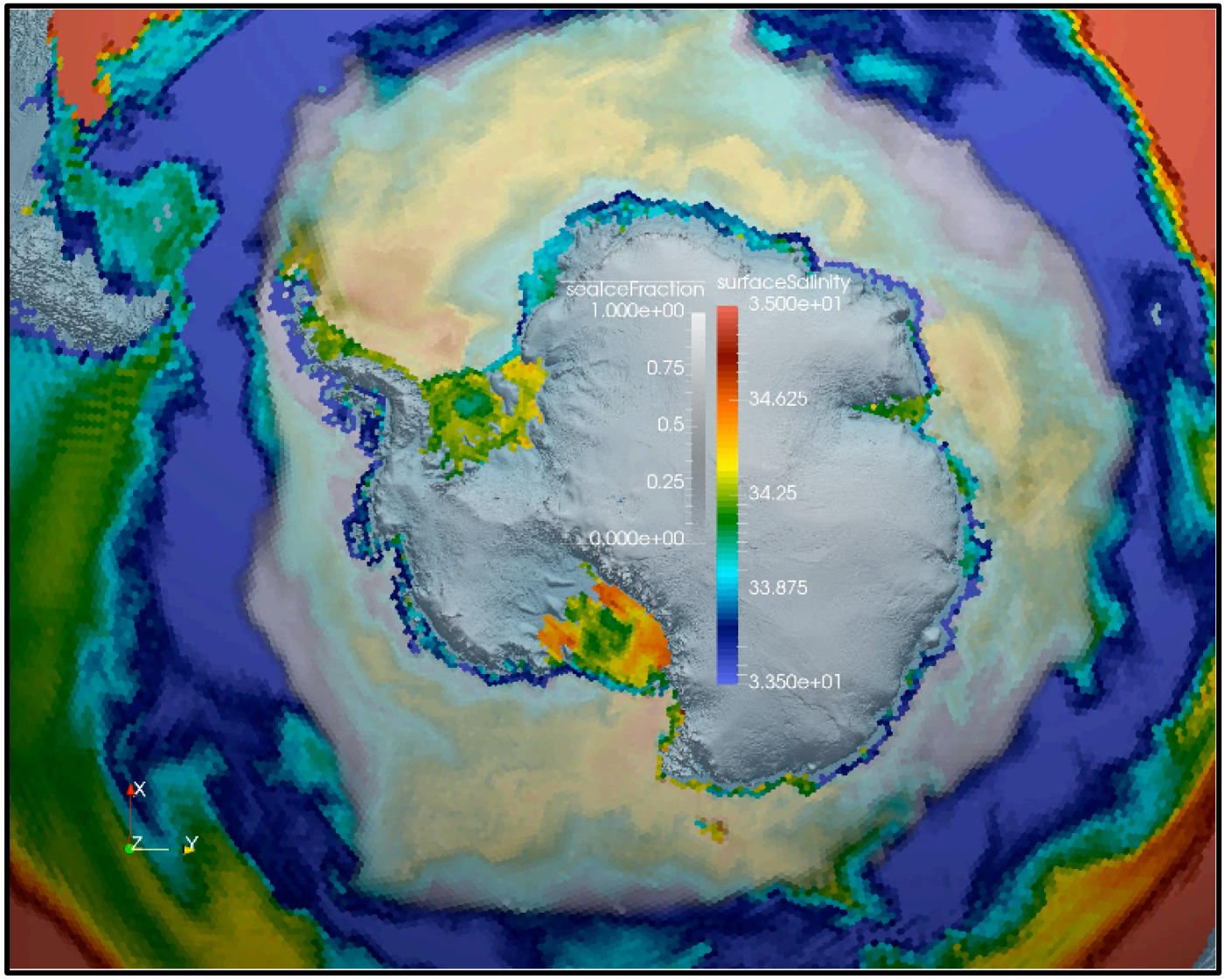
Obs. (SSMI)

MPAS-Land Ice: Optimized Antarctic Velocities on 14-4 km mesh



- Variable resolution 14-4 km mesh
- Target mesh 20-1 km res (~10x larger)
- Albany-Trilinos dycore
- Optimized ICs in from PISCEES

Fully-Coupled ACME Simulation with Ocean Circulation in Ice Shelf Cavities (low-res, Water Cycle, 1850 config.)



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** See talk / posters: *Coupling Ice Shelf Cavities into ACME* and *Ocean Cavities below Ice Shelves* **

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12 Month Plan: Development

Epic	JIRA Epic Link	Epic Lead
Analysis Framework	OG-488 - development / testing of ocean-ice, coupled model analysis framework IN PROGRESS	@Milena Veneziani
Ocean/Land-Ice Coupling (static)	OG-489 - development / testing of support for static and dynamic ocean-to-land-ice coupling (static ice sheets) OPEN	@Mark Petersen
Ocean/Land-Ice Coupling (dynamic)	OG-548 - development / testing of support for static and dynamic ocean-to-land-ice coupling (dynamic ice sheets) OPEN	@Mark Petersen
Sea-Ice Snow Model	OG-490 - development / testing of snow model for MPAS-CICE OPEN	@Elizabeth Hunke
System Support for Calving	OG-502 - development / testing of calving model improvements and calving front motion in the coupled model OPEN	@William Lipscomb
V2 BGC Developments	OG-493 - V2 BGC Developments OPEN	@Nicole Jeffery
Discrete Sea-Ice Floe formulation	OG-494 - development / testing of sea-ice dynamics model based on discrete element methods OPEN	@Adrian Turner
Ocean Isopycnal-Like Vertical Coordinate	OG-495 - development / testing of isopycnal-like vertical coordinate for MPAS-O OPEN	@Mark Petersen
Support for dynamic representation of surface type	OG-496 - development / testing of dynamic surface type in coupled model OPEN	@Jeremy Fyke
component maintenance (ocean, sea ice, land ice, BGC)	OG-492 - component maintenance - ocean, sea ice, land ice, BGC IN PROGRESS	@Doug Jacobsen
standalone, sea ice model testing	OG-528 - Testing of standalone MPAS-seaice model OPEN	@Adrian Turner
triage hub support for ocean-ice	OG-491 - support for triage hub requests - tasks assigned as needed OPEN	@Stephen Price
ocean-ice management	OG-497 - ocean-ice team management tasks OPEN	@Todd Ringler
CORE-II RRS 30-10 km Simulations	OG-498 - support for CORE-II RRS 30-10 km Simulations IN PROGRESS	@Jon Wolfe
CORE-II RRS 15-5 km Simulations	OG-499 - support for CORE-II RRS 15-5 km Simulations IN PROGRESS	@Jon Wolfe
CORE-II EC 60-30 km Simulations	OG-500 - support for CORE-II RRS 60-30 km Simulations OPEN	@Mathew Maltrud

12 Month Plan: Publications

PRM: #GlobalOceanMesoscaleDiffusivity	OG-503 - preparation / submission of global ocean mesoscale diffusivity paper OPEN	@Phillip J. Wolfram
PRM: #SouthernOceanMixedLayerVentilation	OG-504 - preparation / submission of southern ocean mixed layer ventilation paper OPEN	@Luke Van Roekel
PRM: #AntarcticSlopeFront	OG-505 - preparation / submission of Antarctic slope front paper OPEN	@Todd Ringler
PRM: #MesoscaleMixingInTheSouthernOcean	OG-506 - preparation / submission of mesoscale mixing in the southern ocean paper OPEN	@Todd Ringler
PRM: #OverflowCharacterizationOfAABW	OG-507 - preparation / submission of AABW overflow characterization paper OPEN	@Mark Petersen
PRM: #SouthernOceanWaterMassTransformation	OG-508 - preparation / submission of southern ocean water mass transformation paper OPEN	@Todd Ringler
PRM: #MPAS-CICEIntro	OG-509 - preparation / submission of MPAS-CICE intro / overview paper OPEN	@Adrian Turner
PRM: #MPAS-CICEVariableResolution	OG-510 - preparation / submission of MPAS-CICE variable resolution paper OPEN	@Adrian Turner
PRM: #MAPS-SnowonSeaIce	OG-511 - preparation / submission of MPAS-CICE snow on sea ice paper OPEN	@Elizabeth Hunke
PRM: #MPAS-LandIceOverview	OG-512 - preparation / submission of MPAS-Land Ice intro / overview paper OPEN	@Matt Hoffman
PRM: #MPAS-IceOceanCouplingIdealized	OG-513 - preparation / submission of MPAS-Land Ice / Ocean idealized coupling paper OPEN	@Xylar Asay-Davis
PRM: #CouplingAMarineIceSheetToAClimateModelPart1Description	OG-514 - preparation / submission of coupling a marine ice sheet model to a climate model (part 1) paper OPEN	@Jeremy Fyke
PRM: #MAPS-CICEIron	OG-515 - preparation / submission of MPAS-CICE iron paper OPEN	@Nicole Jeffery
PRM: #ACMEv1OceanBGC	OG-516 - preparation / submission of ACME v1 ocean BGC paper OPEN	@Mathew Maltrud
PRM: #ACMEv1MarinePOAprecursors	OG-588 - preparation / submission of marine aerosol precursor paper OPEN	@Nicole Jeffery
PRM:#WeddellSeaPolynya	OG-566 - Formation and maintenance of Weddell Sea polynya IN PROGRESS	@Milena Veneziani

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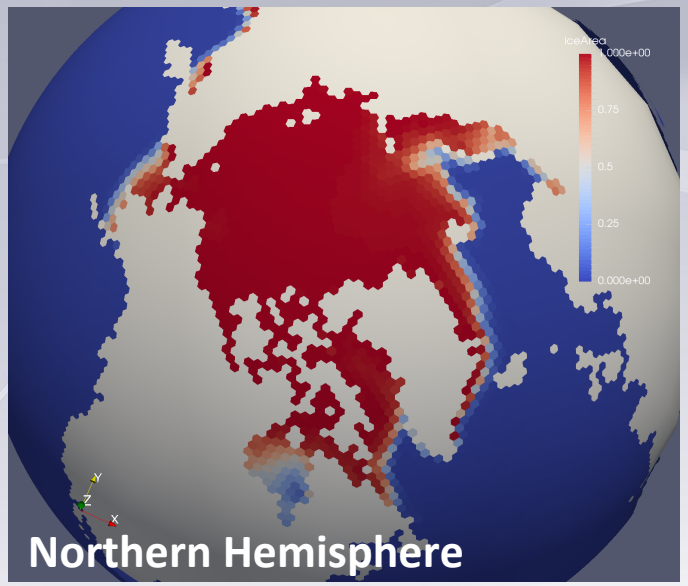
Summary

- Model development and simulation plan largely on track
- Plan is ambitous:
  - model components are new
  - new coupling issues are expected
  - setbacks are expected
- Next 12 months:
  - support for coupled model simulations
  - land ice / ocean coupling
  - analysis capabilities
  - publications

MPAS-Sea Ice



- 50 year standalone run
- CORE forcing
- QU120km mesh
- gx1 CICE standard simulation